[0057] Figure 4A shows the dispenser case 48 with the carousel assembly 30 and transfer bar 44. The carousel assembly 30 is fully loaded with a main roll 66 and a stub roll 68, both mounted on the carousel arms 32 and rotate on the rotating reduced friction paper towel roll hubs 34 (only shown from the back of the carousel arms 32). In the carousel assembly 30, the two carousel arms 32, joined by corresponding bars 40 and cross members 42, rotate in carousel fashion about a horizontal axis defined by the carousel assembly rotation hubs 38. The locking bar 36 is supported, or carried, by a corresponding bar 40. The corresponding bar 40 provides structural rigidity and support. The locking bar 36 principally serves as a locking mechanism. Each paper towel roll 66, 68 has an inner cardboard tube which acts as a central winding core element, and which provides in a hole in paper towel roll 66, 68 at each end for engaging the hubs 34.

[0058] Figure 5 shows the carousel assembly 30 in exploded, perspective view. The number of parts comprising this assembly is small. From a reliability point of view, the reliability is increased. From a manufacturing point of view, the ease of manufacture is thereby increased and the cost of manufacture is reduced. The material of manufacture is not limited except as to the requirements of cost, ease of manufacture, reliability, strength and other requirements imposed by the maker, demand.

[0059] When the main roll, 66 (Fig. 4A) and the stub roll 68, (Fig. 4A) are in place, the carousel arms 32 are connected by these rolls 66 and 68 (Fig. 4A). Placing cross-members 42 to connect the carousel arms 32 with the locking 36 and corresponding 40 bar results in better structural stability, with racking prevented. The locking bar 36, which was shown as a single unit locking bar 36 in the previous figures, acts as a locking bar 36 to lock the carousel assembly 30 in the proper orientation. It acts also as the release bar, which when released, allows the carousel assembly 30 to rotate. Two compression springs 70, 72 are utilized to center the locking bar 36.

[0060] Figure 4B is a side view of the locking bar showing the placement of the compression springs. The compression springs 70, 72 also tend to resist the release of the locking bar 36, insuring that a required force is needed to unlock the locking bar 36. The required force is typically between 0.5 lbf and 3.0 lbf, or more. In this embodiment, the force is 2.0 lbf when the spring in a fully compressed

position, and 1.1 lbf when the spring is in the rest position. In the rest position, the forces of the opposing springs offset each other.

[0061] The actual locking occurs as shown in Figure 4C. The locking bar 36 closest to the rear of the casing 48 is adapted to fit into a generally u-shaped mating structure 118 which is adapted to hold the locking bar 36 and prevent it and the carousel assembly 30 from rotating. When the locking bar 36 is pulled away from the rear of the casing 48, the locking bar 36 is disengaged from the mating structure 118. The mating structure has an upper "high" side 120 and a lower "low" side 122, where the low side has a "ramp" 124 on its lower side. As the locking bar 36 is pulled out to clear the high side 120, the carousel assembly 30 is free to rotate such that the top of the carousel assembly 30 rotates up and away from the back of the casing 48. As the carousel assembly 30 begins to rotate, the user releases the locking bar 36 which, under the influence of symmetrically placed compression springs 70, 72 returns to its rest position. As he carousel assembly rotates, the end of the symmetrical locking bar 36 which originally was disposed toward the user now rotates and contacts the ramp 124. A locking bar spring, e.g., 70 or 72, is compressed as the end of the locking bar 36 contacting the ramp 124 now moves up the ramp 124. The end of the locking bar 36 is pressed into the space between the low side 122 and the high side 120, as the end of the locking bar 36 slides past the low side 122. A locked position for the carousel assembly 30 is now reestablished.

[0062] Figure 5 shows the carousel arms 32 adapted to receive the loading of a new roll of towel 66 (Fig. 4A). The arms 32 are slightly flexible and bent outward a small amount when inserting a paper towel roll 66 (Fig. 4A) between two opposite carousel arms 32. A friction reducing rotating paper towel roll hub 34 is inserted into a hole of a paper towel roll 66 (Fig. 4A), such that one roll hub 34 is inserted into a hole on each side of the paper towel roll 66 (Fig. 4A). Also shown in Figure 5 are the tamper resistant fasteners 74, which attach the friction-reducing rotating paper towel roll hubs 34 to the carousel arms 32.

[0063] Figure 5 shows the surface 76 of the roll hubs 34 and the surface 78 of the carousel arms 66, which contact each other. These contact surfaces 76, 78 may be made of a more frictionless material than that of which the carousel arms 32 and the roll hubs 34 are made. For example, a plastic such as polytetrafluoroethylene (PTFE), e.g., TEFLON ®, may be used, as a thin layer on each of the contacting surfaces. The paper towel dispenser 20 and its components may be made of, including

but not limited to, plastic, metal, an organic material which may include but is not limited to wood, cardboard, treated or untreated, a combination of these materials, and other materials for batteries, paint, if any, and waterproofing.

[0064] Figure 6A shows the paper 80 feeding from the stub roll 68 while the tail 82 of the main roll 66 is positioned beneath the transfer bar 44. The legs (visible leg 46, other leg not shown) of the transfer bar 44 rests against the stub roll. When the diameter of the stub roll 68 is larger by a number of winds of paper towel than the inner roll 84, the legs 46 of the transfer bar 44 dispose the bar 88 of the transfer bar 44 to be rotated upward from the feed roller 50.

[0065] Figure 6B shows the situation where the stub roll 68 is exhausted, so that the transfer bar 44 tucks the tail 82 of the main roll 66 into the feed mechanism 86. Figure 6B shows the stub roll 68 position empty, as the stub roll has been used up. The stub roll core 84 is still in place. As the stub roll 68 is used up, the legs 46 of the transfer bar 44 move up toward the stub roll core (inner roll) 84, and the bar 88 of the transfer bar is disposed downward toward the feed roller 50 and toward the top of a structural unit of the dispenser 20 (Fig. 2), such as the top of the electronics module 132 (Fig. 3). Initially the main roll 66 is in reserve, and its tail 82 in an "idling" position such that it is under the transfer bar 44. The main roll 66 and its tail 82 are not initially in a "drive" position. However, as the stub roll 68 is used up, the downward motion of the bar transfer bar, 44 driven by its spring loading, brings the bar 88 of the transfer bar 44 down to engage the main roll tail 82 with the feed roller 50.

[0066] Figure 7A shows the carousel assembly 30 ready for loading when the main roll 66 reaches a specific diameter. The diameter of the main roll 66 may be measured by comparison of that diameter with the widened "ear" shape 122 (Fig. 4A) on each end of the carousel arms 32. That part of each carousel arm 32 is made to measure a critical diameter of a main roll 66. The carousel assembly 30 is tilted forward when it is locked. The carousel assembly 30 may rotate unassisted after the locking bar 36 is released, due to the top-heavy nature of the top roll. That is, the torque produced by the gravitational pull on the main-roll 66 is larger than that needed to overcome friction and the counter-torque produced by the now empty stub roll 68.

[0067] Figure 7B shows the process of loading where the service person pulls the locking bar 36 and allows the carousel to rotate 180°, placing the main roll 66 in the previous stub roll 68 position. Now a new full sized roll 66 can be loaded